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Article 1

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James Atkinson
Iowa State College

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IOWA AGRICULTURAL COLLEGE

EXPERIMENT STATION,

AMES, IOWA.

FIELD EXPERIMENTS

—WITH—

CORN, OATS, BARLEY, WHEAT, BROME GRASS, RAPE. SORGHUM, SOY BEANS, COW PEAS, AND SUGAR BEETS.

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Field Experiments

JAMES ATKINSON.

An extensive system of experiments with field crops was begun at the Station in the spring of '98. The results of many of these are not ready for publication as it requires several years for their verification. The purpose of these notes is to give some information regarding the principal varieties of farm crops grown in Iowa.

It is not our policy to advocate the multiplication of varieties, but rather to encourage the improvement of those recognized as standard. It must not be understood, however, that varieties not mentioned here are to be regarded as worthless. If results compare favorably with those herein contained, it is not advised that any change be made in the seed used. In addition to the use of good varieties, there are other factors which contribute to success in growing crops, among which soil cultivation and rotation play an important part. It might be mentioned here that clover is given a place every fourth year in our rotation. This, together with the proper care and application of manure, enables us to keep the soil in a high state of fertility.

CORN.

Fifty varieties of corn were grown under similar conditions for the purpose of comparison. We find a great difference in these varieties, especially in their ability to yield profitable returns. It was hoped that a full list of these might be given, together with the yield of each, but a heavy wind storm in the month of August so damaged the crop that the results this year are not strictly reliable. The yield varied from thirty to seventy-five bushels per acre.

The following six varieties may be relied upon as being early as well as good yielders: Golden Beauty, Iowa Silver Mine, Early Yellow Rose, Mortgage Lifter, Capital and Riley's Favorite.

For the southern part of the state, where early maturity is not so important a factor, the following varieties are adapted: Legal Tender, Mammoth Cuban, and Snowflake White.

Corn Cultivation. The manner in which corn should be cultivated is the subject of much discussion. An experiment was begun last season in comparing deep and shallow cultivation of corn. By the former is meant a depth of five inches and by the latter from one and one-half to two and one-half inches. The crop which received two shallow cultivations gave a yield of 70 bushels per acre, while the same kind of treatment five times continued until July 20th gave a yield of 74 bushels per acre. The results of deep culture were 66 bushels per acre where the crop was cultivated twice and 68 bushels from the section cultivated five times. This shows an increase of nearly eight bushels in favor of shallow cultivation and a gain of five bushels per acre in favor of continuing the culture until the crop is well advanced. It will be necessary to continue this experiment for a number of years, but we believe the results are suggestive and worthy of publication at this time. It may be mentioned here that early varieties should be used if cultivation is continued far into the growing season as it causes a delay in ripening. In this experiment the same variety of corn was used in each case.

WHEAT.

The fact that Iowa produces several million bushels of wheat annually leads us to take up a line of experiments, both with winter and spring wheat.

Winter Wheat. As is well known the crop of winter wheat seeded in the fall of '98 was almost a total failure throughout the state. This failure due to winter-killing simply indicates that there is no variety sufficiently acclimated to withstand our severe winters. However, last winter was an exception and should not discourage those who have grown wheat successfully in the past. By close observation during the past winter of the 40 varieties grown on our farm, we noticed that the Turkish Red was the last to succumb to severe conditions. As the milling qualities of this variety are of the highest order, we are led to believe that it is more suited to the conditions of this state at the present time than any wheat on the market.

Spring Wheat. Forty varieties of spring wheat were seeded in the spring of '99. Of this number some half dozen gave satisfactory yields, though as yet none have been found

Experimental Grounds Looking Northwest from Water Tower.

to equal the Blue Stem or Velvet Chaff. This variety gave a yield of 30 bushels per acre on well prepared soil. Prominent among the best varieties were White Russian, Pillsbury, Wild Goose, and three varieties received from the Minnesota Experiment Station. As the Minnesota wheats are the outcome of crosses between the hardy wheats of that state, we are very hopeful of the three varieties that have done so well this season. None of the wheats grown were free from rust but in all cases those freest from it gave the best results. We have begun the work of selecting early maturing plants and in this way hope to shorten the period of growth and thus render the plants less liable to rust.

Preparing Soil for Wheat. In the spring of '98 and '99 corn stubble was prepared for wheat in the following manner: Plot No. 1 received a thorough discing, the disc being used three times. Plot No. 2 was plowed four inches deep in the spring while Plot No. 3 was plowed eight inches deep at the same time. All plots were harrowed until the surface of each was in good condition, and then seeded alike with the press drill. The average results of the two years are given in the following table:

Corn stubble disced	30.5 bus
Corn stubble plowed 4 inches	26.0 "
Corn stubble plowed 8 inches	25.3 "

The soil upon which these crops were grown was a prairie loam partaking more of a sandy nature than of a clayey. The larger yield from the disced soil was no doubt due to the greater firmness of the soil, a condition that seems to be favorable to the growth of winter and spring wheat.

OATS.

Thirty-seven varieties of oats were grown in a comparative test in '99. Of this number eight yielded more than 60 bushels per acre. These were as follows: White Belgian, Early Champion, Red Rust Proof, Nebraska Gold Mine, Silver Mine, Early Dawson, Henderson's Clydesdale, and Black Russian. The largest yield per acre was produced by the Silver Mine while Early Champion gave the greatest weight per bushel. Early Champion ripened six days before any other variety and 18 days earlier than the latest. The former required 88 and the latter 106 days to mature. All things considered we believe this to be the best allround variety on the market at the present time. Its short period of growth and fine light straw renders it a valuable nurse crop, and it is being used more and more for this purpose.

Sowing Rape with Oats The praises of the rape plant are being sung louder each year, especially as a plant for fall pasture for sheep and hogs. In order to find out whether conditions were favorable to the growth of two crops in one season an experiment was begun in seeding oats with rape. Fearing the rapid growth of rape might injure the oat crop the rape seed was sown ten days after oat seeding. Various quantities of both kinds of seed were used but the best results were obtained from sowing six pecks of oats and one pound of rape per acre. The oats in this experiment yielded 60 bushels per acre while the rape produced 18 tons green weight in the month of October. The strong growth of rape interfered slightly with harvesting the oat crop, and we are of the opinion that sowing rape two or three weeks after oat seeding would give excellent results. On poorer land good results are obtained when both are seeded at the same time.

Sowing Oats and Wheat in Mixture. The first necessity in an experiment of this kind is to use varieties that will mature about the same time. We have found by experiment that the White Russian oats and Blue Stem spring wheat are suitable for sowing in a mixture. They were sown in various proportions and in each case the yield from the mixture was larger than when they were grown separately. The following table gives the amount of seed used and the weight of the product per acre:

Oats 4 pecks, wheat 4 pecks	1880 pounds.
Oats 5 pecks, wheat 3 pecks	1760 pounds.
Oats 6 pecks, wheat 2 pecks	1490 pounds.
Oats 7 pecks, wheat 1 peck	1440 pounds.
Wheat alone 8 pecks	1250 pounds.
Oats alone 8 pecks	1040 pounds.

So large an increase as the above could not always expected by mixing grain, but the fact is established that larger returns may be obtained from a mixed crop than when each grain is seeded separately. In this case the increase can be accounted for by the crop standing better and rusting less when the oats and wheat were mixed.

Cutting Back Oats to Prevent Lodging. Probably the most serious drawback to the growth of cereals in this state is their liability to lodge, owing to the great wealth of fertility in the soil together with the prevalence of heavy storms. Lodging renders grain more liable to rust, and even if the crop should escape the rust it seldom fills well after, espec-

ially if this takes place before the grain reaches the dough condition. Last season a field of oats was divided into three parts. Section 1 was cut back with the mower to the base of the third leaf from the ground when most of the plants were showing five leaves. Section 2 was cut lower on the same date, most of the plants on this plot being cut down to the second joint from the ground. The crop was all seeded April 22nd and the cutting back took place June 12th. The plots that received the cutting remained standing long after the other plot had become badly lodged. The following table gives the yield per acre on the three sections:

High cutting	58.2 bushels.
Low cutting	53.4 bushels.
Uncut	46.7 bushels.

It will be seen that the results are very much in favor of cutting back, though it must be remembered that experiments for one year cannot decide a matter of this kind. It should also be borne in mind that cutting back delays ripening. The dates of ripening in this case were July 12th, 16th and 22nd. One has to choose between the delay in ripening and the injury that is likely to be caused by lodging, in this case the former being the better choice.

BARLEY.

The six-rowed barley, Mandscheuri, has given the best results of all the varieties grown on the farm during recent years. The straw of this variety is stiff and bright, the season of growth is reasonably short, and under favorable conditions it is a large yielder, the average during the last two years being 59 bushels per acre. The beardless and hulless varieties were also grown with fair success. The beardless barley, Success, gave an average yield of 45 bushels per acre during the last two years. We favor the growth of this barley as a nurse crop, owing to its early maturing qualities, also for the reason that the yield of straw is light. The best hulless barley gave a yield of 53 bushels per acre during the past year. We also call attention to the early maturing qualities of the hulless barleys, though it must be remembered that a later variety like Mandscheuri will give a greater yield.

SOY BEANS AND COW PEAS.

Varieties of these crops that are suited to this latitude have not as yet been obtained. The early maturing varieties produce lightly, while the later kinds fail entirely to produce seed. Both crops were planted May 26 and harvested Sep-

tember 13th this season. On the latter date the Cow Pea had produced no seed, but gave a yield of 25604 pounds of green fodder, which cured into 6200 pounds of hay per acre. The Soy bean ripened its seed and therefore was of little value for fodder. The yield of grain from this crop was 714 pounds per acre. So far neither of these plants have proved to be soil renovators with us as there has never been any indication of nodules on their roots. Soil was introduced from Kansas last season, soil upon which the pea and the bean had flourished as Nitrogen gatherers, and still no effect was produced on either crop.

SORGHUM.

The value of Sorghum as a hay or fodder plant for this latitude is no longer a matter of conjecture. It has passed the experimental stage so that now we only wish more specific information as to the method of handling the product. An ordinary drouth will scarcely effect a crop of Sorghum owing to its strong root system together with a natural tendency to thrive where moisture is scarce. The first essential in growing it for hay or fodder is a good soil, not only one that is rich in plant food but also in good physical condition. Twenty-five tons per acre of green fodder were produced on the Station grounds last season following an old sod, while on a poorer soil only eighteen tons were obtained.

Seeding Sorghum. When Sorghum is used as a hay crop a large amount of seed should be used. Forty, eighty, and 120 pounds per acre respectively were seeded on different plots. The yields of green fodder from each of these was between 25 and 26 tons per acre. The fodder from the thin seeding was a little coarser and a little longer than was the product from the thick seeding, though not sufficiently coarse to injure the feeding value. The result of this experiment leads us to recommend sowing from 60 to 100 pounds of seed per acre. By using a drill even a smaller quantity than this will give good results. Analysis showed the fodder from the 80 pound seeding to be slightly the richest in protein and fat.

Curing Fodder. Several methods of curing Sorghum were tried. In one case the crop was cut August 24th. During the following week it was tedded several times and put in shock August 30th. September 3rd the shocks were turned out and the following days it was stored in hay mow as ordinary hay. During the curing process the weight was re-

duced from 25 to 8 tons per acre. Oven drying showed that it still contained considerable moisture, but the moisture present did not effect the keeping qualities of the hay. Furthur drying, we believe, would have proved injurious to the crop. Four weeks were required to cure a crop to the same condition when cutting was done the last week of September. Although the sorghum was more mature at this time, yet the cooler weather, the greater rainfall, and the moist condition of the soil greatly interfered with the curing process.

Sorghum is sometimes handled without curing in the sense that hay is cured, but simply put into shock while green to be fed out during the winter months. We found this method to be practical. A portion of the crop was shocked the second day after cutting and when fed two months later came out of the shock in good condition. The greatest objection to this method of curing is that it requires too much labor during the disagreeable winter weather to get the fodder to the stock. We believe that seeding as early as possible in the spring, say the middle of May, and the cutting and curing in the month of August will give the best results. Sorghum may be handled with the binder and shocked as grain. This is a good method, but requires considerable time to cure when handled in this manner.

Composition and Feeding Value. The following table gives the composition of green sorghum which was cut 92 days after seeding, also Kentucky Blue grass and Timothy for the purpose of comparison:

	Water %	Protein %	Crude Fiber %	N. Free % Extract	Fat %
Sorghum	72.0	1.8	8.7	13.9	2.0
Blue Grass	80.0	4.1	9.1	17.6	1.3
Timothy	61.6	3.1	11.8	20.2	1.2

According to this analysis sorghum is somewhat deficient in flesh forming substance though it is rich in fat, and contains relatively a small percentage of crude fiber. Both the green fodder and hay are relished by all kinds of stock. One section was used as a hog pasture and gave good results as such. During the summer season the green fodder was fed to milch cows with most excellent results. After curing, the hay was fed to the working horses during the season of fall plowing, and seldom have we had horses thrive better. We found that by placing other kinds of hay in the manger

Experimental Grounds Looking Southwest from Water Tower.

along with the sorghum the latter in every instance would be the first to disappear.

BROME GRASS.

The ability of this grass to withstand drouths solicits for it some consideration under such conditions as exist in this state. It is favorably known in the northwest, the Dakotas, Nebraska and Kansas, and the manner in which it has withstood severe conditions in these places led us to undertake some experiments with it.

Method of Seeding. In the spring of '98 thirty pounds of seed were sown on an acre of good, clean soil, a soil that had produced a crop of beets the previous year. The seed was sown in April without a nurse crop and covered after the manner of a grain crop. From this acre one and one-half tons of cured hay were taken the following August of the same year. The favorable condition of the soil had much to do with the success of this crop, as another soil seeded at the same time and in the same manner did not produce enough to be worth cutting the first year, owing to a large growth of annual weeds. Some lots seeded without a nurse crop in the fall of '98 came through the winter without injury, though on account of the winter wheat being killed in the immediate vicinity of this experiment it was necessary to plow the land and thus destroy the grass. However its early and vigorous growth in the spring seemed to give evidence to the effect that the month of September might be the most suitable time for sowing. When sown in this manner it will meet with less opposition from the growth of annual weeds in the spring.

Spring Seeding with a Nurse Crop. In the spring of '99 a crop of oats, spring wheat, and barley were each seeded with 30 pounds of Brome grass seed per acre. The grass germinated, but at harvest time it was nowhere visible, it having been completely smothered out by the nurse crop in each case. It being a vigorous grower, a check of this kind proves more injurious than it would to such plants as timothy and clover. A continuation of this experiment may produce results that will conflict with this, and yet we are of the opinion that this grass will have to be seeded on clean land without a nurse crop in order to obtain the best results.

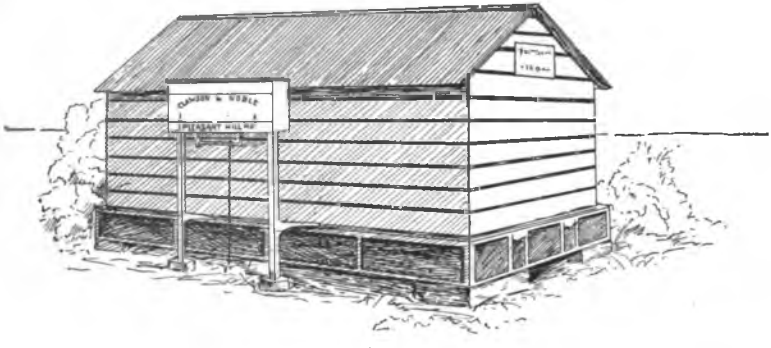
Value as a Hay Crop. Owing to its extreme hardiness it is one of the first plants to begin growth in the spring when once established. In case of a one-year-old sod, it began

to head out six weeks after growth began in the spring. The same crop was cut and gave a yield of 12 tons of green fodder June 10th, which cured into 5 tons of hay. It must be remembered that the soil upon which this was grown was very rich. A bare soil, treated in the same manner, produced less than one ton per acre. According to Station analysis, it is quite similar to timothy in composition. If seeded thickly and cut at the proper time, it is a little superior, owing to the leafy nature of its growth. At time of cutting, the leaves were stripped off a portion of the crop, and it was found that there was a greater percentage of leaf than of stem.

Production of Seed. The plot seeded in the spring of '98, and cut the same season for hay, was allowed to stand until July 12th in '99, when it was cut for seed. It yielded 300 pounds of seed per acre, and at time of cutting the leaves were still succulent. However, it required so long to cure, being cut with the binder, that the feeding value of the plant was much impaired by the time the product was in a condition to thresh.

CORN SHRINKING EXPERIMENT.

In the fall of 1898 an experiment was begun with a view to finding out the annual shrinkage of ear corn. The difficulty usually met in an experiment of this kind is that the movement of the corn at intervals for weighing purposes removes it from ordinary "crib" conditions. To overcome this difficulty a crib was constructed upon the platform of a pair of scales. For this purpose a scale was furnished by the firm of



Corn Crib on Scale.

Clawson & Noble, Pleasant Hill, Mo. This scale is so constructed that the works are above ground, thus affording an opportunity at all times to observe the working of its parts

and removing to the greatest possible extent any source of error in the weights. Seven thousand pounds of corn were husked and stored in the crib Oct. 19, 1898. The crib is 13½ feet long by 7½ feet wide, thus making the conditions normal for corn storage. After storing, the corn was weighed once a week for a year. These weights show some variations due to weather conditions, which in all probability affected the crib more than the corn, but in periods of three months this variation is so slight that the following data may be considered the normal shrinkage of the corn:

Cultivating Corn on College Farm.

During the first three months, or from Oct. 19th to Jan. 19th, the loss was 630 lbs., or 9 per cent of the original weight. From Jan. 19th to April 19th the loss was 390 lbs., or 5 4-7 per cent of first weight. During the next three months the loss was 220 lbs., or 3 1-7 per cent of original weight. During the last three months—that is, from July to October—the loss was 190 lbs., or 2 5-7 per cent of original weight. The loss during the whole period was 1,430 lbs., or a fraction more than 20 per cent. This means that a bushel of corn

weighing eighty pounds in a condition similar to this will weigh sixty-four pounds at the end of a year; or, if calculated to weigh seventy-five pounds at time of storing, will weigh sixty pounds after having been stored for one year. It, no doubt, would have been interesting to have allowed the corn to remain in the crib during the second year, as the after-drying of the corn indicated that there still remained considerable moisture; but, instead of doing this, the crib was emptied and a fresh supply stored, it being the intention to find out the variation to be found in corn from year to year. When this is determined, a permanent supply will be stored and allowed to remain until the weight is constant.

The following table gives the weekly weights of the corn during the year:

Oct 19	7000 lbs	Mar 1	6245 lbs	July 5	5825 "
" 26	6835 "	" 8	6225 "	" 12	5780 "
Nov 2	6715 "	" 15	6310 "	" 19	5760 "
" 9	6475 "	" 22	6280 "	" 26	5700 "
" 16	6430 "	" 29	6235 "	Aug 2	5730 "
" 23	6540 "	Apr 5	6220 "	" 9	5800 "
" 30	6425 "	" 12	6100 "	" 16	5740 "
Dec 7	6410 "	" 19	5980 "	" 23	5730 "
" 14	6380 "	" 26	5950 "	" 30	5700 "
" 21	6380 "	May 3	5970 "	Sept 6	5670 "
" 28	6375 "	" 10	5940 "	" 13	5640 "
Jan 4	6375 "	" 17	5950 "	" 20	5610 "
" 11	6370 "	" 24	5925 "	" 27	5630 "
" 18	6370 "	" 31	5900 "	Oct 4	5570 "
" 25	6360 "	June 7	5860 "	" 11	5620 "
Feb 1	6330 "	" 14	5860 "	" 19	5620 "
" 8	6310 "	" 21	5880 "		
" 15	6290 "	" 28	5840 "		
" 21	6250 "				

It will be observed that the weights indicate an apparent gain at certain intervals, due to weather conditions. The moisture content of this corn was taken at the beginning and end of the experiment, so that, by ascertaining the condition of a crop as compared with this, one can compute very nearly what the shrinkage will be, noting weather conditions at time of weighing.

SUGAR BEETS.

Experiments in the growing of Sugar Beets have been carried on at the Station for a period of ten years and have been reported in previous bulletins. The results of all our work up to date indicate that Iowa conditions are favorable to the production of beets of superior quality for sugar making purposes. The work done during the past two years but

substantiates previous reports from this station. The results of twenty plots grown in '98 are given in the following table:

	Per cent Sugar	Per cent Purity
Plowed and subsoiled	12.40	80.35
Just plowed	12.95	80.95
Just cultivated	13.10	82.40
Rows 16 inches apart	13.14	82.51
Rows 20 inches apart	13.26	83.69
Rows 28 inches apart	12.48	82.14
Rows thinned to 6 inches	12.46	82.18
Rows thinned to 12 inches	12.79	82.87
Two tons lime	12.70	81.27
One one-half tons lime	13.00	83.17
One ton lime	12.62	82.33
No lime	12.90	82.92
400 lbs salt	13.46	85.08
300 lbs salt	12.70	82.18
200 lbs salt	12.85	83.08
100 lbs salt	13.20	82.75
No salt	12.68	81.87
20 tons F. Y. manure	12.20	80.75
10 " " " "	12.67	81.46
No manure	12.31	80.64

As the results in the above table are the average of five analyses, the source of error is indeed small, and in every instance without regard to treatment the quality of the beets was considerably above the standard. Indeed the samples taken just as the crop ripened showed higher percentages than those given. The possibility of deterioration after the fall rains commence is shown in the following table:

	Sugar	Purity
Harvested October 15	12.58	81.50
" " 22	12.23	81.23
" " 29	12.88	84 89
" November 4	13 94	85.93
" " 11	12.29	77.58

The above results are an average of twenty samples in each case and point to the necessity of having the crop taken up at the proper time.

The experiments in methods of cultivation were continued in '99. The stand of beets was somewhat poor owing to unfavorable weather after planting. On this account the methods of treatment could not be compared, though the crop was cared for and the beets analysed, giving as an average of the twenty plots a sugar content of 12.13 per cent. with a purity of 79.46 per cent.